



## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

--000:0:000--

In re Application of

Ryuichi ISHII et al.

Serial No. 09/725,234

Filed: November 29, 2000

For: HEAT-RESISTING STEEL, METHOD FOR THERMALLY TREATING  
HEAT-RESISTING STEEL, AND COMPONENTS MADE OF HEAT-  
RESISTING STEEL

Group Art Unit: 1742

Examiner: SIKYIN

TECHNOLOGY CENTER 1700

DEC 17 2001

RECEIVED

--000:0:000--

Honorable Commissioner of Patents and Trademarks  
United States Patent and Trademark Office  
Washington, D.C. 20231

Sir:

RECEIVED  
JAN 07 2002  
TC 1700

DECLARATION UNDER 37 CFR 1.132

I, Ryuichi Ishii, the undersigned, a citizen of Japan and a resident of 4-11-15, Chuo, Edogawa-ku, Tokyo, Japan, do hereby declare that:

1. I am one of the co-inventors of the invention described in the above-identified patent application entitled "HEAT-RESISTING STEEL, METHOD FOR THERMALLY TREATING HEAT-RESISTING STEEL, AND COMPONENTS MADE OF HEAT-RESISTING STEEL" which was given United States Serial No. 09/725,234, and accordingly I

am familiar with the content of the present application.

2. I graduated from Tokyo Institute of Technology, Faculty of Engineering, Department of Metallurgy in March 1989, and finished the Master's Course, Tokyo Institute of Technology, in March 1991.

3. Since April 1991, I have been employed by KABUSHIKI KAISHA TOSHIBA, assignee of the above-identified application, where I have been engaged in research and development of steels, especially heat-resisting steels, in Metals and Ceramics Technology Group of said KAISHA.

4. In order to establish the patentability of the present invention, I would like to submit additional experimental data to prove that the incorporation of aluminum into the claimed steel compositions brings undesirable effects and that this deterioration can be caused by a coarse residue formed by oxygen and aluminum in the steel. The particulars are as follows.

#### Preparation of heat-resisting steels

30 kg of a sample steel was subjected to vacuum induction fusion, and then to casting. The cast ingot was forged at a high temperature, annealed, and then normalized. This ingot was subjected to oil hardening, followed by tempering. According to this manner, two types of steels, P13A1 and P13A2, were prepared. The chemical compositions of these steels are as shown in Table 1. For a better comparison, Table 1 also shows the chemical composition of steel P13 of Example 2 in the present specification, which is encompassed by the claimed invention. All of these heat-resisting steels have been controlled to have a tensile strength of approximately 750 MPa as described in Example 2 in the present specification.

Table 1

	C	Si	Mn	Cr	W	N	B	V	Ti	Al	Fe
P13	0.23	0.09	0.23	2.31	2.44	0.019	0.007	0.31	0.023	-	balance
P13A1	0.22	0.08	0.25	2.05	2.32	0.019	0.011	0.28	0.024	(0.006)	balance
P13A2	0.22	0.09	0.28	2.18	2.39	0.017	0.009	0.29	0.021	(0.025)	balance

As shown in Table 1, the compositions of steels P13A1 and P13A2 were similar to that of steel P13 of the claimed invention, except that these steels contain aluminum. Since the current claims clearly exclude aluminum, steels P13A1 and P13A2 are categorized as Comparative Examples in that these steels contain aluminum.

#### Evaluation of heat-resisting steels

Steels P13A1 and P13A2 were subjected to a tensile test, a creep rupture test and a Charpy impact test in the same manner as in Examples of the present specification. Specifically, the tensile strength at room temperature (MPa), the creep rupture time at 600°C under 196 MPa, and the absorbed energy at 20°C were measured. The results are as shown in Table 2. In this Table 2, the result of steel P13 is also shown for reference.

Table 2

Type of Steel	Tensile Strength at Room Temperature	Creep Rupture Time at 600°C-under 196 MPa	Absorbed Energy at 20°C
P13 (0%Al)	735MPa	1068h	78J
P13A1 (0.006%Al)	742MPa	(803h)	(62J)
P13A2 (0.025%Al)	740MPa	(597h)	(35J)

The results summarized in the above Table 2 show that, when the claimed steels additionally contain aluminum, both the creep rupture time at 600°C and the absorbed energy at 20°C are significantly reduced. This means that, in the claimed steels, the existence of aluminum deteriorates the important property for heat-resisting steels. I believe that this result supports my consistent assertion that aluminum element, in a coagulating

process, can bond to oxygen or nitrogen to form an oxide or nitride, which is an undesirable coarse residue in the steel.

In order to further support this assertion, steel P13A2 was subjected to EPMA (Electron Probe Micro Analyzer) analysis. Specifically, aluminum and oxygen distribution in a certain section of the steel P13A2 was measured by using EPMA, respectively.

The result is shown in an attached distribution image map. In this map, the image shown in the leftmost column represents the distribution of oxygen, while the image shown in the middle column represents the distribution of aluminum. The multi-color bar shown in the rightmost column represents the index which relates each color with the content of target elements. Therefore, according to the multi-color bar index, the red-colored areas in the leftmost column indicate a higher oxygen concentration, while those in the middle column indicate a higher aluminum concentration.

As shown in the attached distribution image map, both of oxygen and aluminum were concentrated or localized in substantially the same areas in steel P13A2. In view of this, it is considered that most of aluminum in the detected area of steel P13A2 exists in the form of oxide, i.e., alumina. It is therefore concluded that, when a heat-resisting steel contains aluminum, aluminum oxide formed in the steel deteriorates both the creep rupture time at 600°C and the absorbed energy at 20°C, which are important properties for the heat-resisting steel.

I further declare that all statements herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or

imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated: November 20 , 2001

Ryuichi Ishii

Ryuichi ISHII

Attachment: Distribution image map measured by using EPMA

